People admiring *don* Ramón's mango production hear that he didn't do much: "Cover crops do it all". Photo: Horacio Narvaez, MACRENA

Cover crops do it all

Integrating cover crops and green manures helps farmers rehabilitate degraded soils in highland areas. In Ecuador, farmers experimented with this conservation practice. They found that it improved their farming system in many ways: increased productivity in their main crop, decreased weeding time, provided them with an extra crop (for food, fodder, marketing), besides rehabilitating their soils.

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Agricultural soils in Ecuador are highly degraded. Deforestation, together with practices such as monocultures and farming on steep slopes, has contributed to the disappearance of fertile soils. The subsoil, largely made up of hardened volcanic sands, is now widely visible. Another indicator of this degradation is seen in diminishing levels of the soil's organic matter content, and therefore in its structure stability and nutrient content. The use of agro-chemicals has worsened the situation. It is thus more appropriate to talk about the "rehabilitation" rather than the "conservation" of this resource.

Naturally, the first step to consider in such a rehabilitation process is to look at the necessary changes in local practices. Given the well-known effects of organic matter, Ecuador's Management of Natural Resources Network, MACRENA, in alliance with World Neighbors and the McKnight Foundation, decided to focus on the best ways to ensure enough organic matter, especially on small scale farms. As part of our search for alternatives to current practices, we visited many successful experiences in Mexico, Central America and Brazil, recognising the uses and benefits of cover crops and green manures. As the use of cover crops is not common in the Andean highlands, we started working with a network of innovative farmers from the low, medium and high areas of the country's northern highlands.

Advantages of cover crops

"Cover crops" refer to additional crops that are integrated alongside the principal crop; or to cover the land when it is left fallow, to protect the soil from the erosive effects of wind, rain and high temperatures. Similarly, "green manures" are cover crops grown to maintain or increase the soil's organic matter content, and raise its overall fertility. These are fast growing species which are chopped and buried in the same place where they grow, before flowering – which would divert the concentration of nutrients to the seeds or fruit. Cover crops and green manures have similar and complementary advantages, including:

- protecting the soil from erosion, drying up, and improving soil moisture levels and water circulation;
- impeding the development of weeds, either directly (by blocking light) or indirectly (some species are known to act as herbicides);

- enriching the soil with nitrogen (for leguminous green manures) and other nutrients;
- creating new habitats for natural enemies of pests and disease organisms;
- contributing to a better soil structure as a result of greater soil biological activity, and mechanical action of roots;
- contributing to building up the soil's organic matter and humus content, activating the soil fauna and micro-organisms; and
- providing for a more humid environment which helps break down hard residues such as straw in cereal systems, balancing the carbon and nitrogen ratio.

The most common species used as cover crops or green manures are generally beans or pulses, grasses and also crops from the *Cucurbitaceae* family. They must be able to grow in poor soils; produce great volumes of green mass in a short time; be water-efficient; and have a dense root system. On the other hand, they must also be easy to eradicate, as they cannot become invasive weeds. Their use is subject to several restrictions and demands, which are not only linked to the species but also to the particular farming conditions. Cover crops, for example, must not stop the adequate heating of the soil in the colder highlands; sowing and growth must be cheap; they must not represent a source of pest or disease for the main crop; and the liberation of nutrients must coincide with the time that the crop needs them. Preferably, they should not compete in terms of labour and time with the commercial or subsistence crops. Finally, it is important to compare both systems in economic terms.

Promising green manure and cover crops

On mountains ranging from 1500 to 3400 m above sea level, the highlands of northern Ecuador present a diversity of ecosystems, covering Andean valleys, steep slopes and highland plateaus. Many farmers, together with MACRENA and World Neighbors, have been experimenting with cover crops and green manures in different ecological zones, trying to prove the benefits in the soil and their positive effects on the main crops in these areas. Working in different ecosystems is generating experiences and information which can then be adapted in other high Andean regions. Until now, farmers in the lower valleys have been using mucuna (*Stizolobium* sp. or *Mucuna pruriens*), *Canavalia ensiformis*, dolichos or lablab bean (*Lablab purpureus*), pigeon pea (*Cajanus cajan*) and other beans (such as *Phaseolus vulgaris* or *Arachis pintoi*). Farmers in the higher areas have used common beans, as well as peas, oats, alfalfa, *Vicia* spp., lupin (*Lupinus* spp.) and the "torta" or lima bean (*Phaseolus lunatus*).

Although the soil rehabilitation process can take many years, the effects of using cover crops and green manures can be noticed immediately. One example comes from the results achieved by *don* Ramón Alcívar and his family. He is one of the farmer researchers belonging to EcoAmbuquí, a farmers' organisation. His farm is found in the Ambuquí parish, in a valley known as Chota, at an altitude of between 1500 and 2000 m. This is a semi-arid area, with an annual rainfall of only 500 millimetres. Two years ago, *don* Ramón started experimenting with cover crops; he sowed six different kinds of beans between his mango trees.

Don Ramón's experience

The cover crops grew well. It was only necessary to weed the field once after sowing. At the same time, however, the first problem appeared: *don* Ramón and his family started panicking when they saw how the beans were climbing up the growing mango trees: "Will these beans suffocate the mango?" The solution was to control the way the vines were growing, cutting them with scissors. There were no further difficulties, and *don* Ramón carried on with his crops. Now, after two seasons, he exclaims:

> *"Cover crops are marvellous. I only needed to sow them once. The first thing you notice is that weeds stop coming up, so I don't have to spend money or time in weeding. Then I found out that these beans produce a lot of seeds. I harvested many beans which I shared with my neighbours and also with other members of EcoAmbuquí. I kept a part of the cover crops in the ground and so they keep growing on their own, so I didn't need to sow again. Now I have a twenty centimetre cushion of organic matter and a lot of earthworms and soil animals have appeared, all of which break down organic material. The most incredible thing is that the ground stays humid for longer, so the watering frequencies have also changed. Now I don't need to water my field every week, but every three to four weeks!"*

Having had cover crops and green manures for two years, the changes taking place in the soil are visible to the naked eye: there is a new layer, formed by decomposing organic material. The topsoil in *don* Ramón's farm now has a different colour. And there is also a clear difference in the soil's nutrient content. During these last two years, *don* Ramón and his colleagues took a series of soil samples. Comparing the fields where they grew two types of mucuna, lablab and *Canavalia*, they found a significant change in the soil nitrogen of up to 35 percent. None of the other measured properties showed significant differences.

Yields and crop performance

In relation to yields and crop performance, and backing similar previous work on cover crops and green manures, *don* Ramón has more to say:

> *"Now I have more time to dedicate to other things like my own family. What surprised me most was that plants alongside green manures are bigger and greener than those without them. I started harvesting, and found out that these crops produced almost twice as much as those without them. I harvested my mangoes every week for two months, and money came in every week. My wife is happy and now also recognises the benefits of green manures and cover crops. People from other communities come to see my field and even people from other provinces have come. When they see my beautiful mangoes they ask me: What did you do? I answer, ' Nothing, cover crops do it all'".*

Implemented by World Neighbors, the COVERAGRI project supports many farmers like *don* Ramón, all of whom are busy building more sustainable and productive systems. All of them are based on better soil management techniques, and on the *in situ* generation of organic matter. Our project began with a small farm and a seed bank of 2 kg for multiplication. Today, the different small farms managing cover crops and green manures cover almost 30 hectares. We plan to continue expanding this area using a farmer-to-farmer model. We also plan to start working in different ecological zones in the near future, especially at higher altitudes, where we expect to make an important contribution to the reconstruction of degraded soils. This will help increase the profitability of local agro-ecological production. ■

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